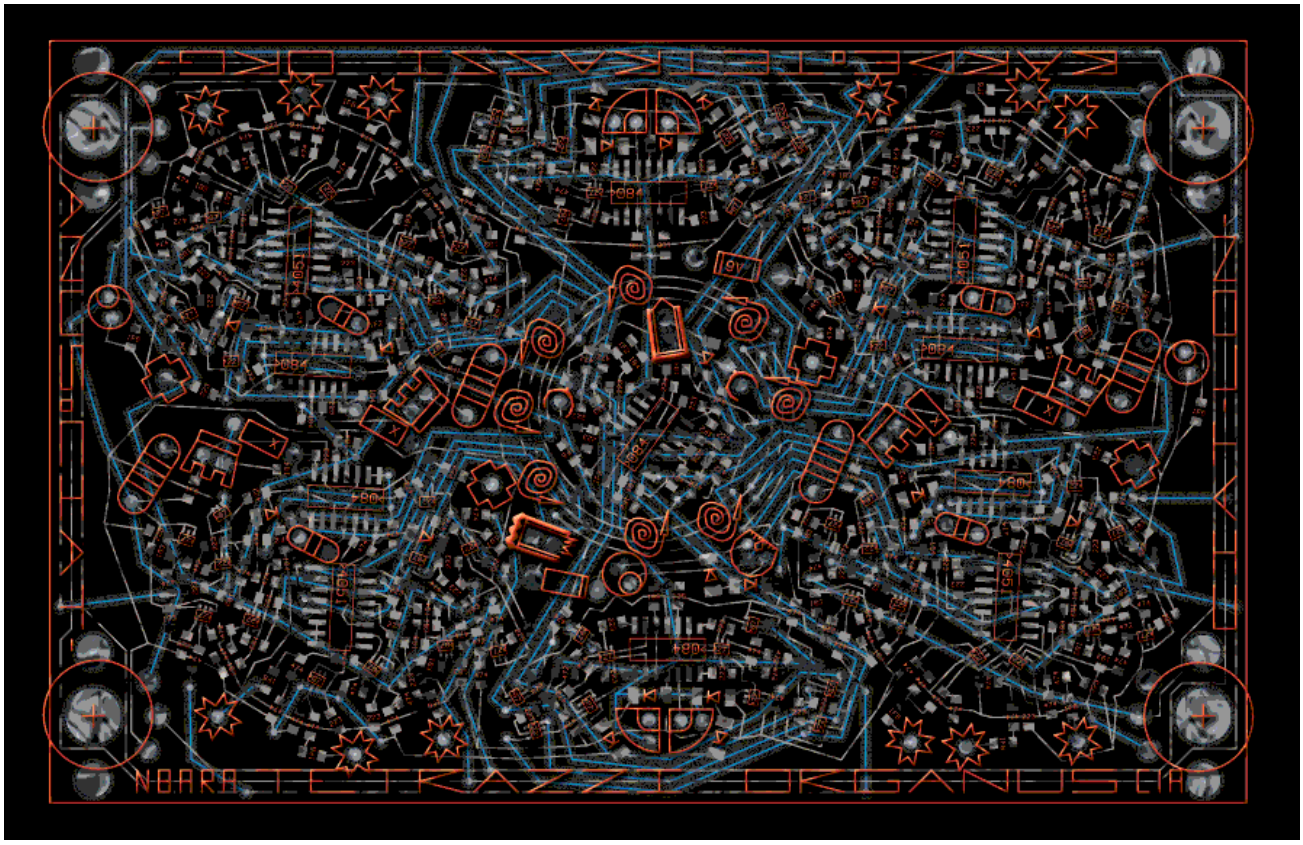

Tetrazzi Users Manual

Encasure
- Wooden Case supplied by Ciat-Lonbarde
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- Other Possibilities
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Technical Evaluation

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if you want to try piezo differential movement:

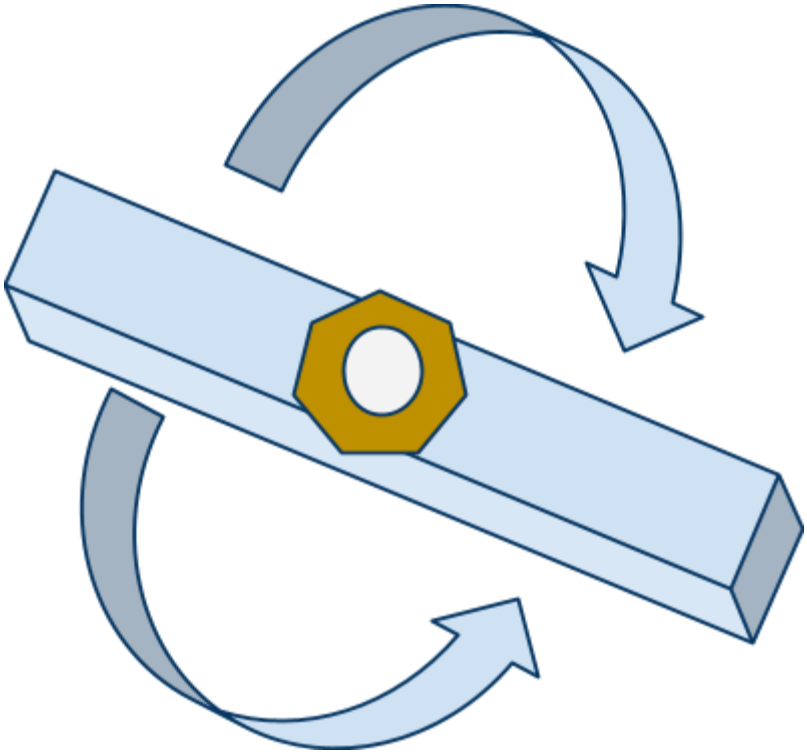
Encasure

If just the Tetrazzi board is what you are receiving, then you will create your own case. It is designed to accept 4 buttons, 4 piezos, and four potentiometers (knobs), as well as power, battery, and two output jacks. Ciat-Lonbarde has designed an ever-evolving line of wooden cases to suit this board, and thus the board was initially designed to be housed in a wooden case. The Tetrazzi board has many delicate components in it, that said, if it is screwed down securely to a plane and level surface, it should be well enough protected from unnecessary flex--- ironically the case is designed to deal with great flex but the circuit board is static. There is something to be said for wood as protection from shock; it will bend or compress when dropped thus protecting the board within from vibration shock. Also wood is light weight. Thus it is secondary only to a factory cast plastic clamshell in structural efficiency.

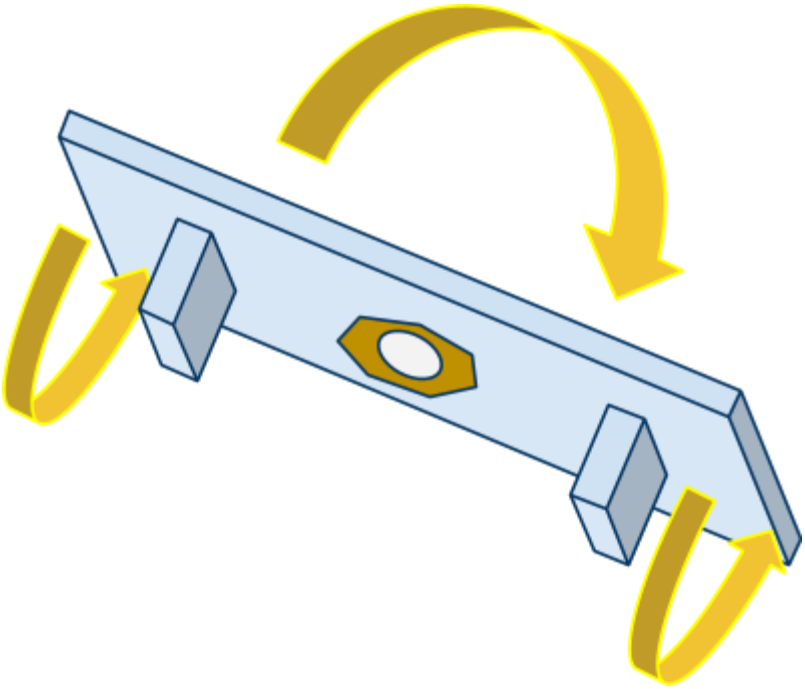
Wooden Case supplied by Ciat-Lonbarde

case-flexure, barre-flexure, pieZo-flexure

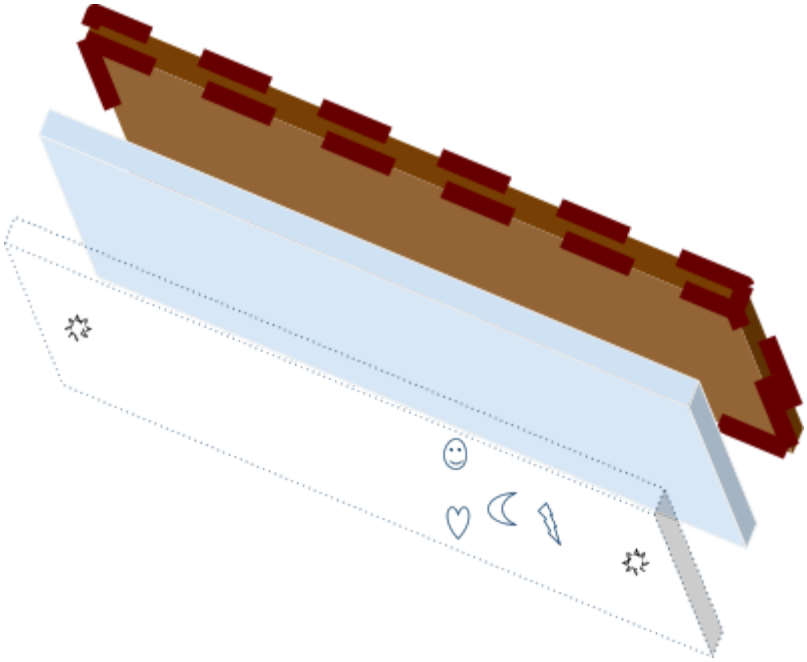
The analog organus system is designed to enable polyphony with simple touch. To understand the fundamental concept behind the analog organus system, we must look at what flex is. Newton described an apple tree which grows up out of the ground, only to let fall an apple back into the ground, perhaps through a human digestive system. Thus it is with flexure. Any solid material bends up as pressure is applied, and then bends back down when pressure is released. The case of the instrument distributes this two-way flexure when you squeeze it, and we can design barres that focus this flexure into one area, as well as provide feedback to the user.



Originally, I slapped a piezo, upside down on a piece of sheet rubber, and passed that off to S___ as a touch sensitive interface, using the original "V-DOG" circuit, a translation of forward and reverse pressure into stereo amplitude levels. He immediately broke the delicate crystal with one honking thumb-press right in the bulls-eye. Thus I conceived that there should be a barre, to which the piezo is glued on the underside, so that the total squishiness of the barre does not exceed the squishiness to break the piezo; this pressure applied by a medium construction worker being tender or, perhaps an agitated child horsing around. There is a simple technique to replace any piezo, so in the end an instrument may be repaired by such a technique. This is covered later on. by the way, the piezo inputs on the circuit board each have diode protection so that it does not electrically exceed 0-9 volts, due to the fact that a flexing piezo can easily provide 30 volts or more!



Actually, there is a doubling of functionality in a barre if you lever it the right way. This goes back to summer of 2006, I was demoing the Sidrassi Organus at Baltimore Artscape, in a tent provided by Promotion and the Arts (BOPA). After noticing that kids loved the intuitive node-patching interface, i also was watching how most adults, upon sighting the instrument, approached it as a xylophone, or marimba, where notes are struck out. I exhausted my throat that day, explaining that it is not a marimba, because of how the barres are anchored. They are not anchored at about .22 from each end, as is the golden ratio to make a marimbarre sonic. Actually, to get more flex, the barres are screwed down at their ends, so this does damp the acoustic audio somewhat (although brass seems to resonate no matter what, cymatically), but **it does not change the electro-synth tone.** But going back to the marimba. If we think about anchoring the bar more towards the middle, we can imagine the bar boinging out at the ends and boinging in in the middle, and vice versa; it is a differential lever! So if you are playing barres in the middle, and it is making a general left to right pattern, you can also play on the ends, to reverse the rotation of stereo tones. This innovation will be explored in further instruments, but on the official Tetrazzis, the case is designed to be as compact as possible, although it has a little bit of extension on each barre to experiment with this effect.



Barres can be wood, metal, or plastic. If you use metal, you cannot embed nodes in the barre, although you can still glue a piezo on. For this reason, Tetrazzi cases are not sold with metal barres, although you can always by the board and create your own case. Usually a wooden bar should be about 7/32" thick, 1.5" wide, and 6.5" long. It is drilled once on each end with a 7/64" bit that includes a countersink, for nesting a #4x3/8" brass wood screw with countersink head. Then it is drilled 4 times in the node pattern, from the bottom up, with a 3/32" countersink bit, so that the node screws can

Other Possibilities

-Chicken Carcass

-Racquetball court made of isolated plywood panels that flex separately

-Mayonaisse jar, looks like someone is thinking about a sandwich!

Here's How they're made at CIAT LONBARDE

So first we have to choose woods. This round was made with Sycamore, a neutral and quite grainy, in a cellular way, wood, for the back. The Sycamore's grain is going perpendicular to the grain of the barres. The Sycamore is a traditional back wood for the violin family. When quarter-sawn it has a fractal effect visually. It is also very pliable, somewhat like Empress, but heavier. So perpendicular to its grain I glued and clamped ribs of Ipe, bandsawn to the organic waveform. Between each double rib there is enough space to fit one template circuit.

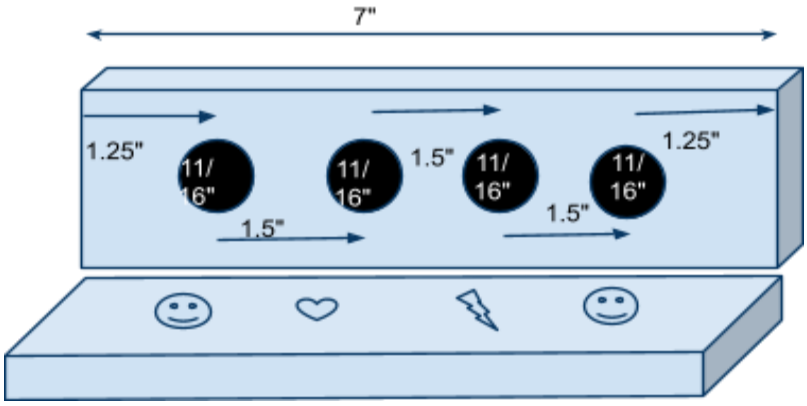
Doing it in batch form enabled me to clean up the whole strip in two cuts on the table-saw (although I did do one pre-cut on the band-saw, to my penciled straight-edge). After

table-sawing, the edges are perfect and clean, ready for high pressure glueing.

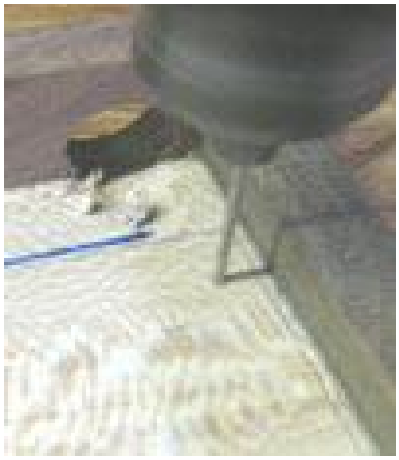
after glueing, i cut the whole situation again on the bandsaw, with compound organic results on the edges, quite pleasant. Here's a nativity from the scraps, surrounded by army of organs.

High pressure glueing is done with orange clampes. The front and back of the instrument, "stiles", are each drilled in four places, with certain cuts:

- for the buttons, there are four 11/16" holes, spaced at 1.5"
- For the back, there are four equally spaced holes:
- Smiley faces are a special three point jack cut:
- 1" on the outsides, 1/2" on the inside. This puts meat in the middle for the barre screw.
- Heart is a 1/8" cut to slip the battery snap thru.
- Lightning is 1/2" cut to fit the power jack in.

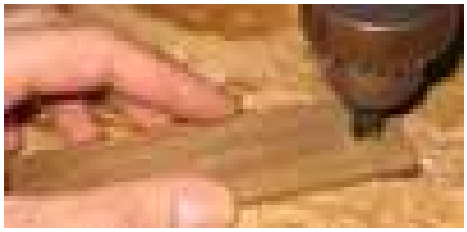


Sometimes the sycamore needs to be whittled a little to fit the jack in:

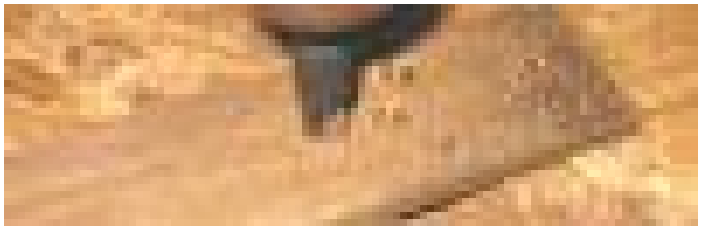


The 4-point board rests are drilled 1/16"

The case outline is traced on the barres.

 Two screw bores on the barre, with a #10 countersink bit.

then a triangle is drawn between mount and middle.
a middle point is drawn in the triangle, for tetrahedron.

 these four points are drilled, from the inside out,
with a #6 countersink bit for hard wood,
#4 countersink bit for softwood.
These 4 points are for the nodes to be screwed in.
The countersink is a slight "solder cup" on the inside of the barre.

Ass'by

List of parts with the full kit

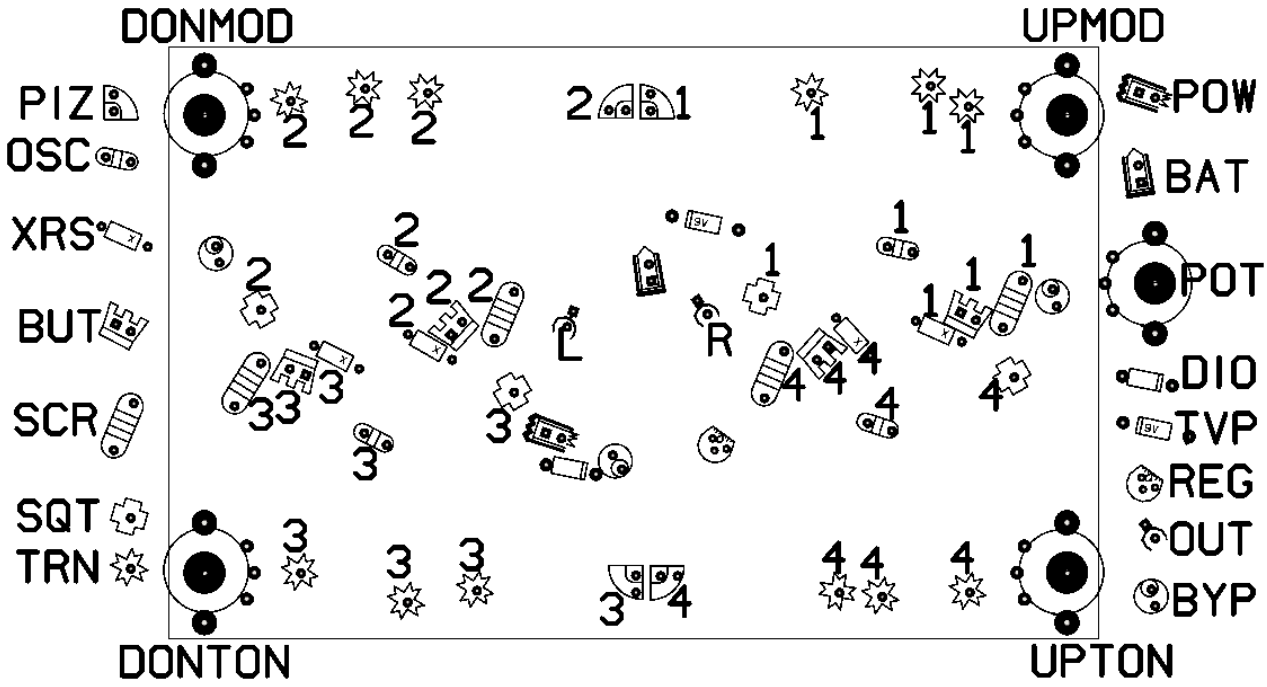
- one tetrazzi circuit board, 3.5" x 5.5"
- 4 thumbwheel potentiometers,
- 4 momentary pushbuttons
- 4 piezoelectric transducers
- 2 output jacks
- 1 battery connection
- 1 DC input jack, 2.5mm
- 1 big diode, 1n4001
- 1 16v 470microfarad capacitor.
- 1 to-92 regulator, l78s09
- 1 Transient VOltage Protector, p6ke10a
- 24 brass screws, countersink head, #4-3/8"
- 4 iron screws, round head, #4-1/2"
- 4 nylon spacers, #4-1/4"
- 3 hanks of normal communications wire
- (1 hank has 8 wires, about 10" long)
- 4 bolts of thin piezo wire
- (one bolt is one wire folded at 10")

Things you will need

- soldering iron
- solder
- sponge to clean tip of soldering iron
- nippers
- wire strippers
- wood glue (aliphatic resin) is good
- 1/16" drill for final barre mounting

Tet Symbols

Observe the following chart, this is what you see when you look at the tet board.
To Orient, look for the little NBARA and CIA, which are in the bottom left and right corners on the board.



The symbols are listed on the left and right margins. On the left, symbols that are related to each of 4 oscillators:
PIZ is where the piezo will connect, brass margin to the outer side of the symbol, inner ceramic to the inner part of the symbol.
OSC is optional, it is a place to connect a capacitor in parallel to alter the main frequency of the oscillator.
XRS is also optional, it is a place to connect a resistor in parallel to alter the frequency of the analog scroll.
BUT is where the button for each oscillator connects, to trigger the analog scroll.
SCR is optional, it is a place to connect a capacitor in parallel to alter the frequency/hold-stability of the analog scroll
SQT (squout) is a single variable-duty-cycle pulse output, transmitting this oscillator as a code into **nodespace**.
TRN (trin) are three touchable inputs for "circuit bending" each oscillator, using **nodespace**.

On the right, symbols that are global:
POW is for connecting external "wall-wart" power supply. Ground goes to the square junction, and positive 12v dc is applied to the circular junction.
BAT is for connecting a 9 volt battery snap. The red wire goes to the round hole, and the black wire goes to the square hole (through the DC power connector)
POT symbolizes four potentiometers, labeled "donmod", "upmod", "donton", and "upton". If you choose to use your own pots, just extend wires from the three small pads on the

symbol and connect the middle one to wiper of your own pot, outer pads to outer lugs.
DIO is a beefed up input diode, 1n4001, handling higher current for DC inrush on the powered input. make sure the band is as in symbol.
TVP is transient voltage protection on the power rail. p6ke10a. same deal with the band.
REG is a TO-92 9 voltage regulator for power input. Align the L78s09 so that the flat face is to the flat face of the symbol.
OUT is one of two output connections, square to ground, circle to signal.
BYP is bypass capacitor, electrolytic, ground is circled. the outer ones are optional,for bypassing the main rails. the inner one is 470microfarads, for filtering DC power input.

Screwing nodes in

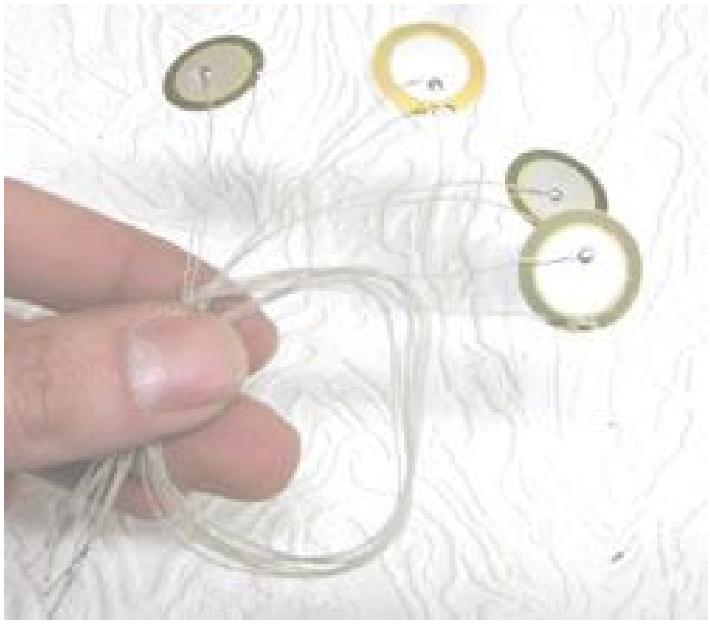
using the case as a brace,

screw 16 brass screws at the tetrahedra,

using the 16 washers to wedge it up.

Soldering the Piezos

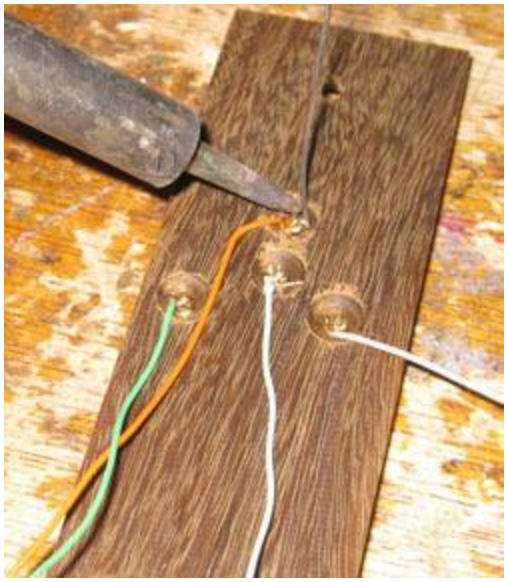
here are four piezos that i made.
the more delicate ones have higher electro-static capacitance.
so, soldering them is a delicate affair.
use the thinnest wire. these have copper covered wire,
which you strip with a flame, and then rub with your nails
to bare it, make it coppery.
then, you can tin each one.
the goal is to hover an ultra-fine soldering iron over it
and dribble a little bit of solder over it onto the piezo
you will see, it is so easy to break a piezo with heat.
fortunately they are cheap to replace. these are AB2025's



on each tasseld piezo, mark the side of the bolt that connects to brass with a sharpie.

Barre Tying, PIEZO GLUEING

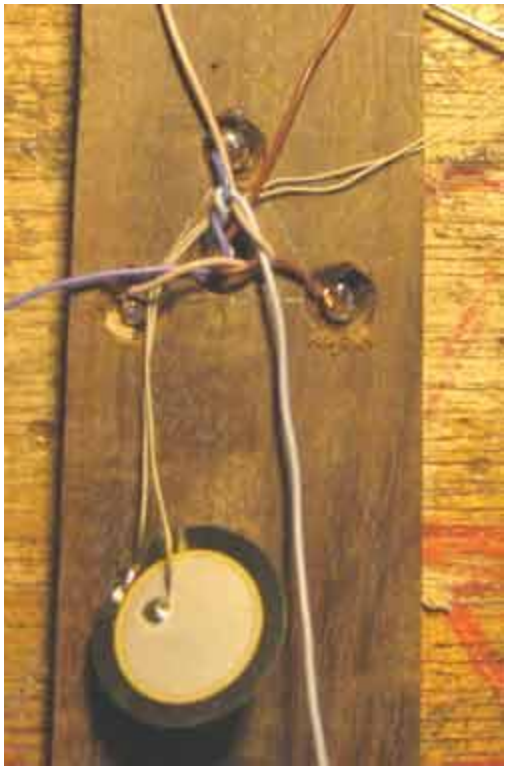
once you've established your piezo situation
and their tassels, u can solder to the barres.
Use four full lengths of normal wire,
strip from both ends, a little on one, a lot on the other
use the lot to wrap around the little screw nub in the cup,
then solder with a hot iron:



now i will teach you a knot for anchoring the piezos
first make a cross over the piezo tassel:

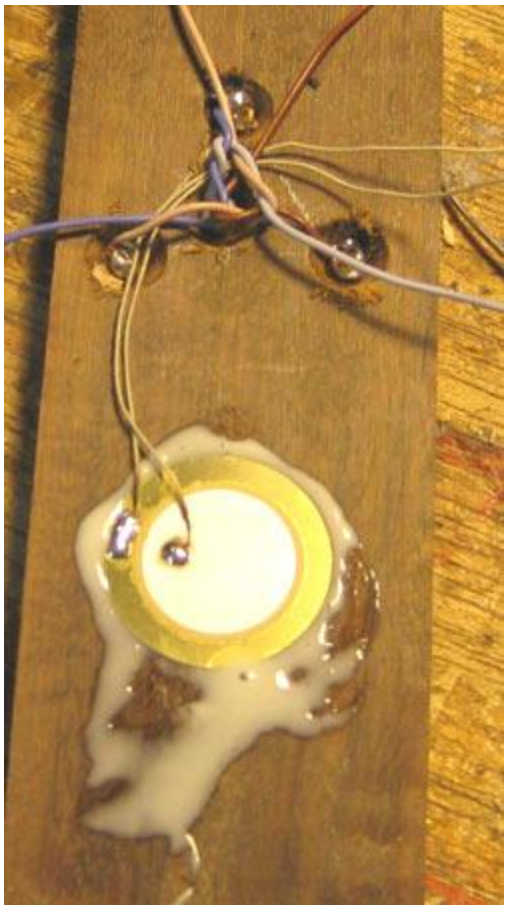
now make another cross with the other two wires:

now take these two crosses and cross them with two new knots
not knot in 4d, newt knows:



this is just a simple way to brace the piezo.
it is modified in many ways, if a tetrahedron
is upside down. now rub glue bnth the piezo:

gently press it down, voila:



the piezo will not work until it is dry

Soldering the power components

There are four power components. Clockwise from top:

- 9 Volt TVP, Transient Voltage Protector, p6ke10a, gray band to left.
- 9 volt REG, Regulator, l78s09, flat faces back.
- BYP, 470 uF Electrolytic Capacitor, 16 V, Ground as shown.
- 1N4001 Diode, DIO, gray band to right.

Pull the leads through and tight.
If you can fold the electrolytic over and out of the way.
Flip the board over and solder them:

Screwing Down the bord

Use the four iron screws.

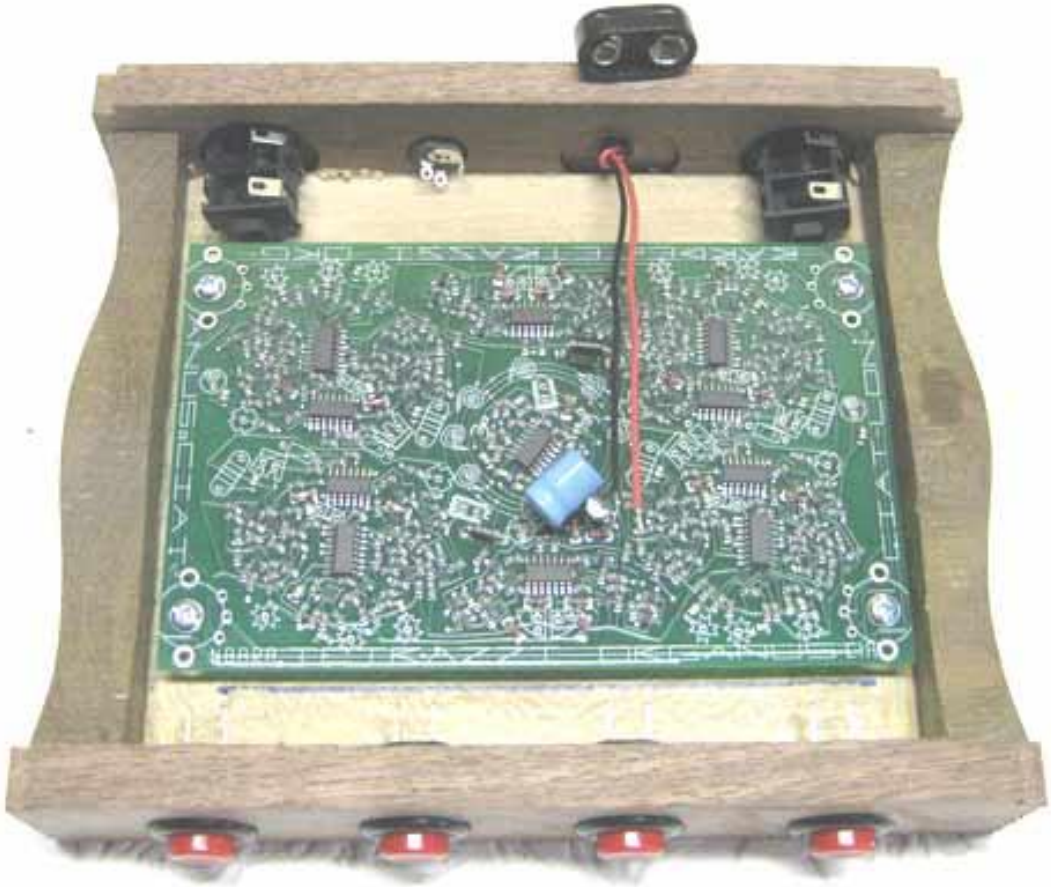
Put the four nylon spacers down first,

(over each hole)

don't screw too tight, that it deforms the board!

Installing front and back components

- (on top) the two out jacks are on the outside
- (on top), the battery snap is slipped in, and tied to prevent horse-jerking
- (on top), the dc power plug is glued in.

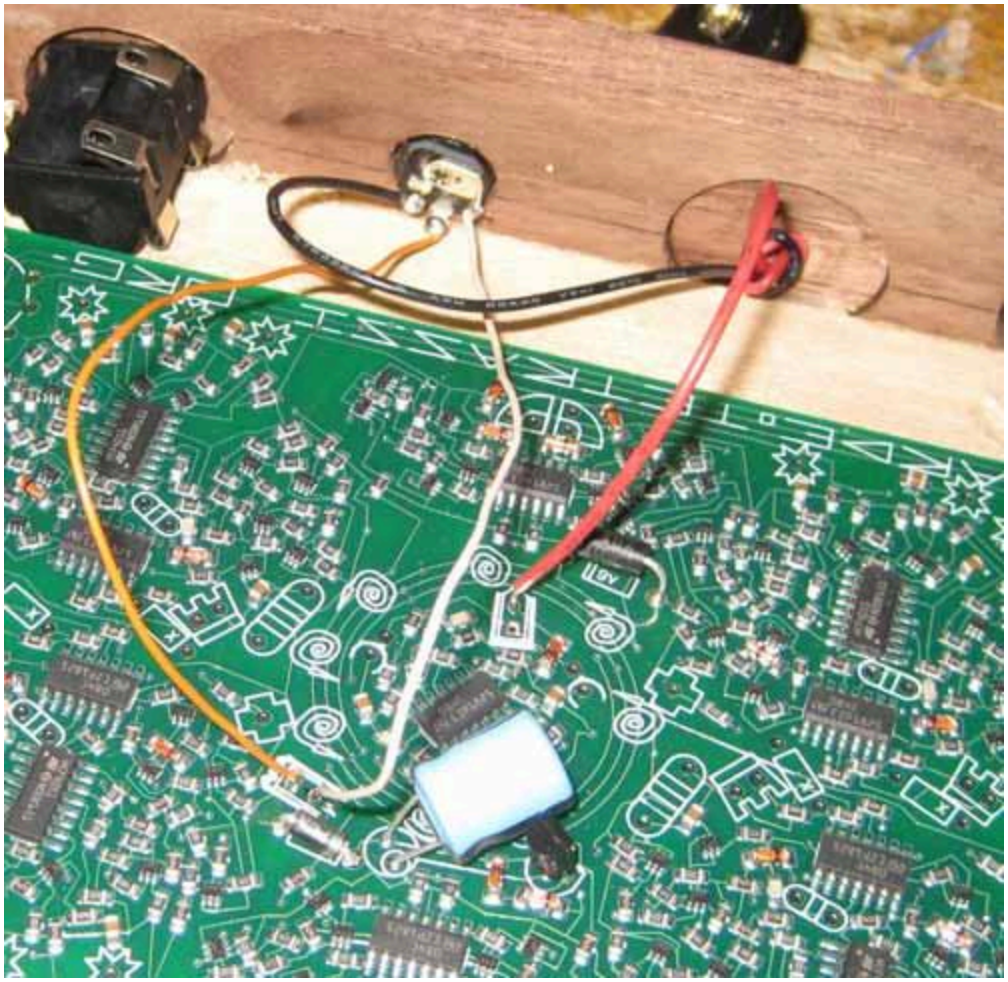


- on the bottom, the four buttons are glued in with a dab of wood glue.

Wiring Power

- the black wire from the battery clip goes to the inner ground lug
- this is to switch it off when DC power is plugged in
- the outer ground lug goes to "ground" of the instrument
- the biggest lug of the power plug is 12Volts
- Now observe the following diagram (it is an older one):

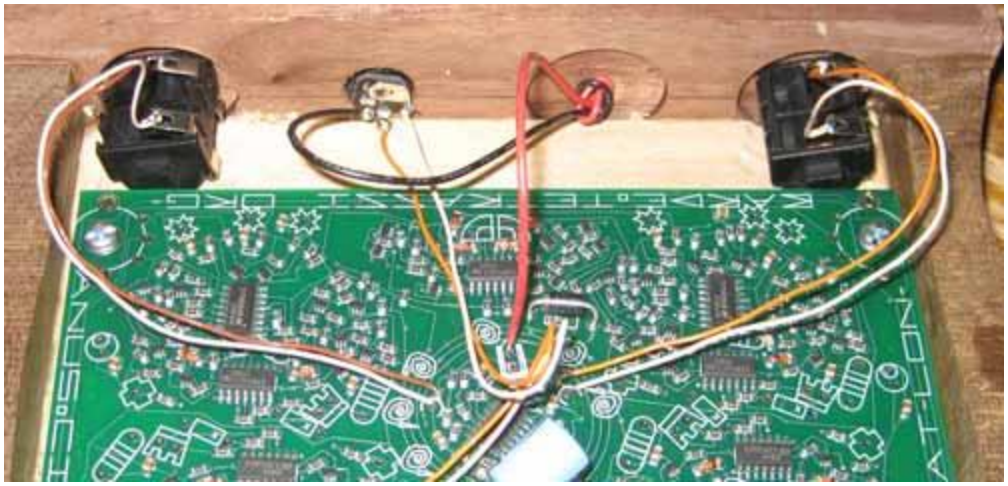
on your tetrazzi, there are the BAT and POW symbols
Ground (here orange) is conferred upon the square node of POW
12V DC (white) is conferred upon the circle node of POW
The Red wire of the battery snap goes to the circle node of BAT
The black wire goes to the inner ground lug of the DC plug.



note the folded over electrolytic cap

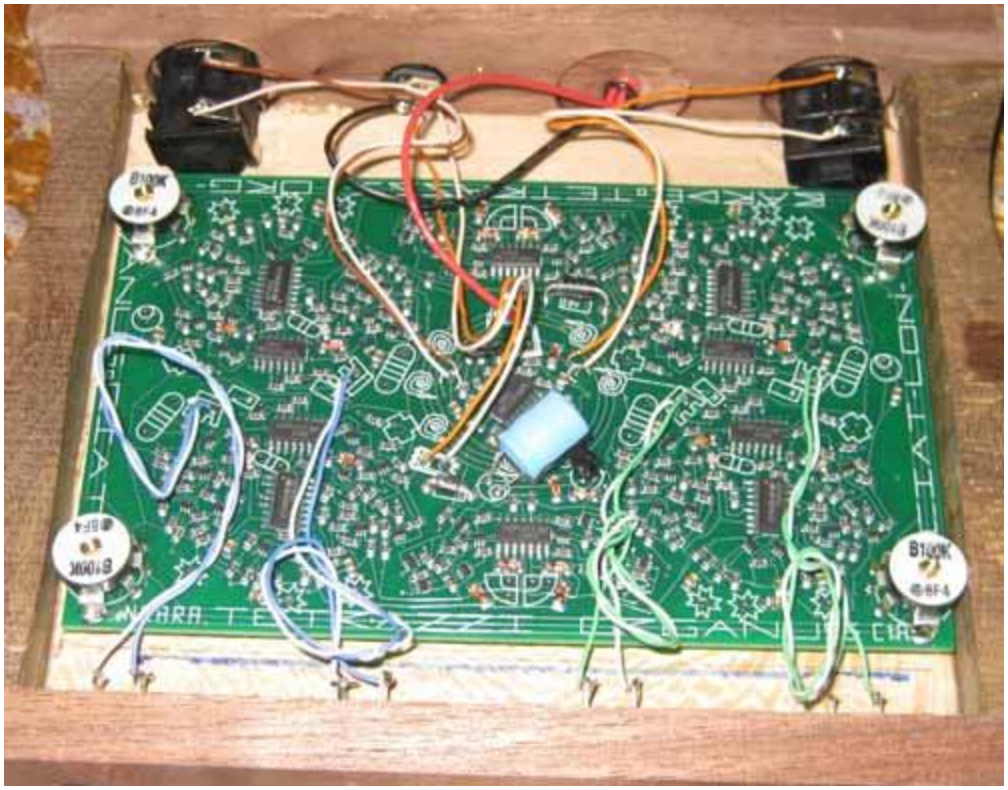
Wiring Outputs

ok, keep it simple. Ground is the lug that is closest to the case, always.
Ground connects to the square node of the OUT sprout symbol
Signal (here white) connects to the circle node of the OUT sprout.



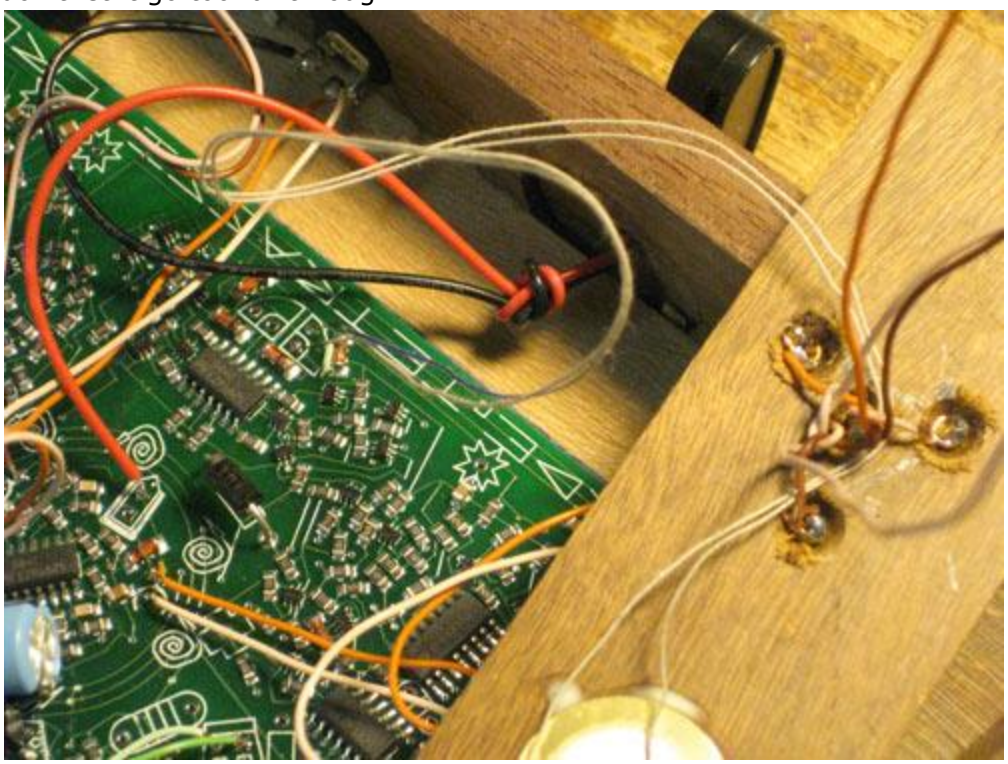
Wiring Buttons, Install Pots

ok, i've installed the four pots now. solder all five legs
the buttons connect to the BUT symbol.
They go in order from left to right.
they can be either which way as related to BUT.
BUT does have two sides, but only for modding's sake.



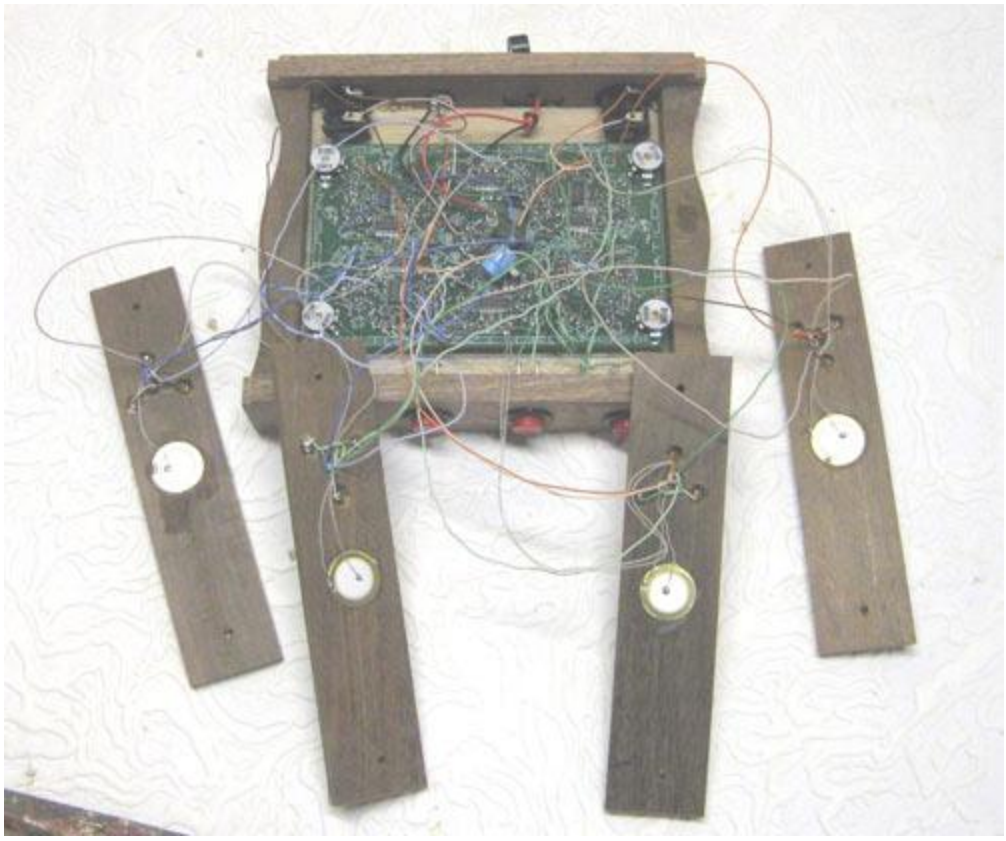
Wiring the piezos to the board

now, cut the piezo tassel to shape (I had let the fold be till now)
the side that you marked, the brass side, goes to the outer edge of PIZ.
soldering tiny wire is a delicate process.
don't let it go too far through!



Wiring the nodes to the board

Ok, so i have the barres layed out in the right order (3241) to match the buttons
now, i take the node wires of each, find the middle, and connect this to an arbitrary SQT node
then three other wires of the triangle, I connect each to a TRN from another section.
the goal is to put one SQT surrounded by three TRNs on each barre, and have instant touch to bend up the whole instrument.



Screwing the barres down

Now, I have left the case undrilled for the last eight mounting screws.
This is because i don't know exactly how they will land up in your arrangement.
you can space them up to a paper's thickness.
nicely neatly pack the wires up inside.
then put the barres down and pencil each hole in
and pilot it with a 1/16" bit.
don't let it go too deep to drill into your components!!!!!

Composing a power supply

please feed me 12V DC, > 200 ma
TIP positive
SLEEVE ground
2.5mm plug

Technical Evaluation

Does it work?

The Tetrazzi Organ make a faint whimper when plugged in to the power supply.

Troubleshooting

> Hope you feel better soon. Good news on tet boards. I bet you learned a
> lot going through the whole process, does it seem like a viable
> manufacturing process for future projects?. How did the Noh theater go?

yes it is pretty damn viable,

we shall no for certain soon, when i check the bords,

then we will know how these 10microfarad ceramic surface mount caps shape up.

they are in the scroll circuit, also output, input decouplers.

they replace electrolytic or poly caps, and they should have the same crispness as the latter

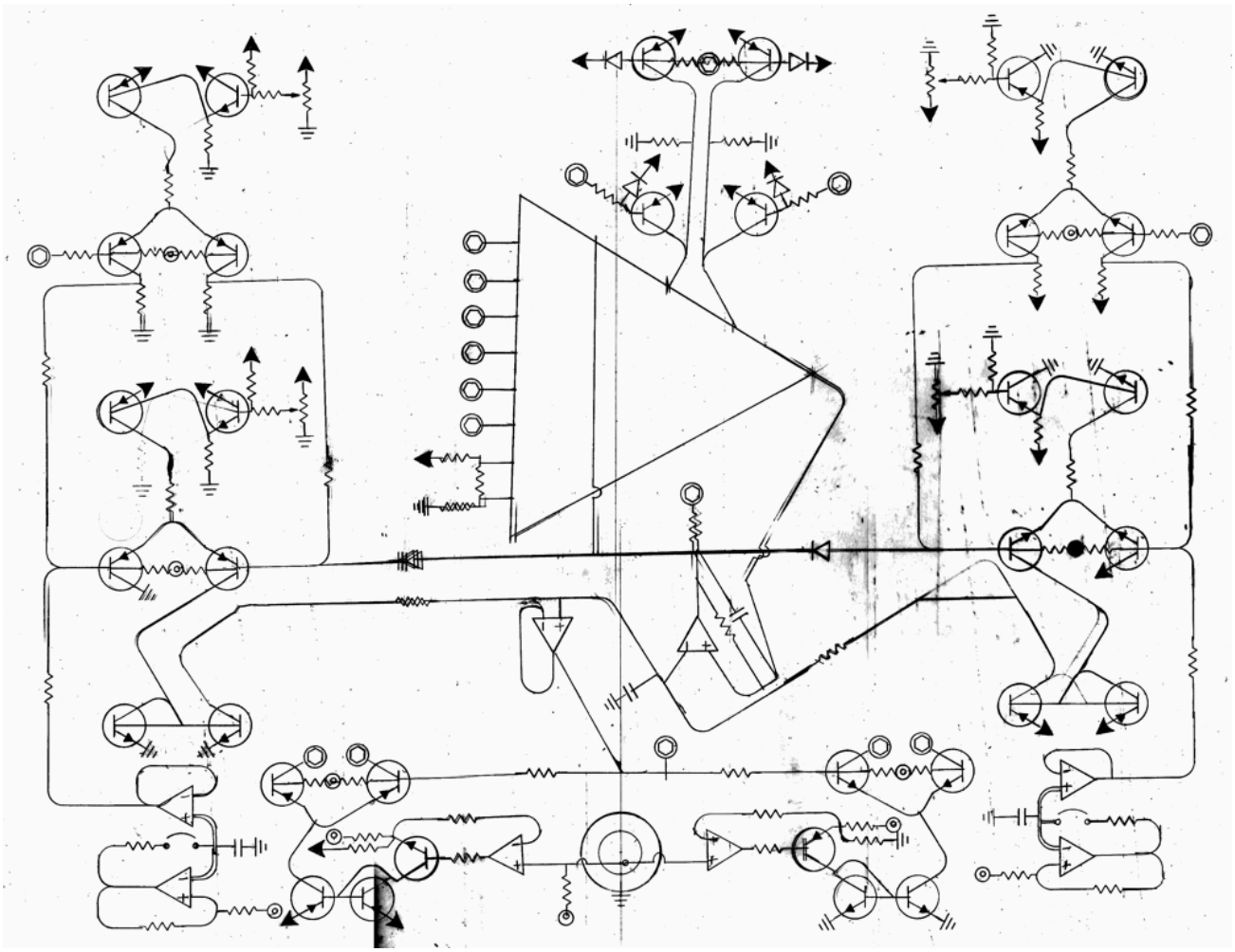
with the bulk mass of the former.

onee thing that is important, is they are rated for 10V, so someone could kill an input by plugging it into the speaker cone of a PA, not likely but should be cautioned agains.

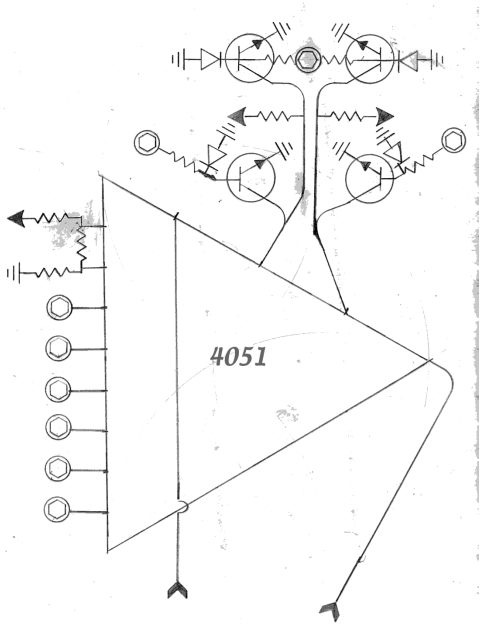
Schematic

following is an informal schematic, which lacks resistor codes, and is intended mostly to get a feel mostly for the analog flow. It does not include power circuitry which is simple enough to be described in words (*power comes in, through diode into big bypass capacitor, then into regulator which is also grounded, and out through a diode into the main power feed)*, neither does it detail the cross-wiring behind the circuit bending feature, which is shown simply as an analog multiplexer.

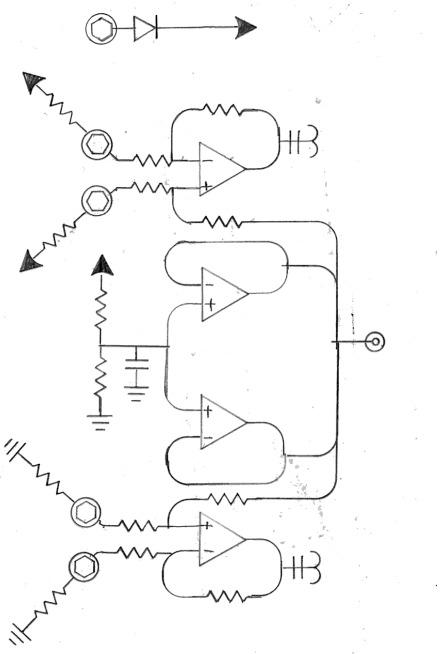
general schematic of one variable-duty-cycle push pull oscillator:



analog multiplexer:



stereo output preamp circuitry:



Modding

If you have just a bord:

connect to the signal pin of PIZ to modulate amplitude with an external LFO. this is cool because its a stereo response. connect a capacitor in beseries [in between in series] of the signal .1 microfarad or greater, to have the signal normalized to silence, peaking left and right with upwards and downwards gestures respectively.

one caveat- don't treat the outer "brass ground pin" as true ground. It is not 0 volts, it is 4.5 volts appomattox.

now, you can also send a cv into the DONMOD UPMOD DONTON UPTONzzzz.

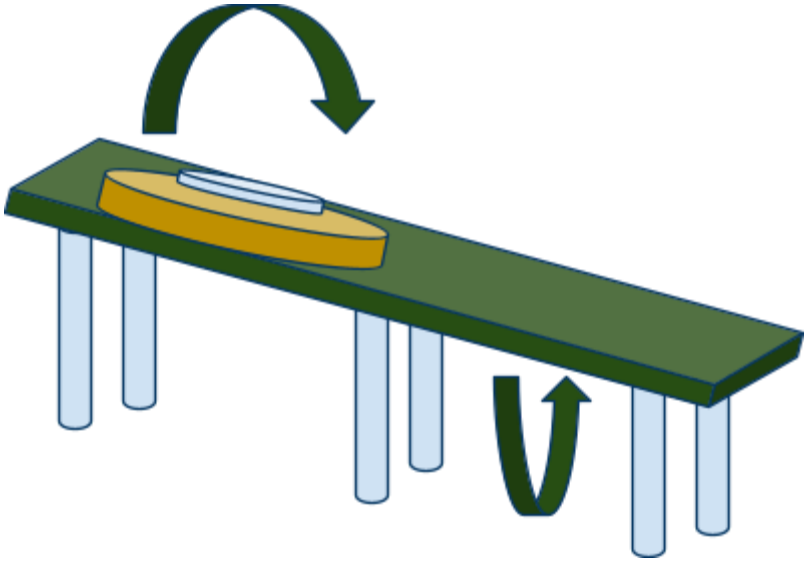
the potentiometers have 0 and 9 volts at their outer lugs, and the "input wiper" is in the middle.

you can do CVin, resistor mixer with a pot, in to the "input wiper"

you can also connect to the round pin of BUT, leaving the square pin out (which is square wave feedback for the scroll oscillation). just using the round pin gives you CV control of the scroll (frequency and duty cycle) of each oscillator.

the star TRNs and cross SQT are optimized for fingers, or wire. The TRNs are capacitors to a transistor amplifier, then on to the circuit-bending-circuitry. The SQT is a resistor from the square out opamp circuitry. you can use this SQT in your modular synthesizer, it can be pulse, square, rectangle, depending on scroll. You can input primitive waveforms, pulsey are best, into the TRNs.

if you want to try piezo differential movement:



remember that a lever can be designed to make a push into a pull, thus enabling the user to send opposite "s-curves" to the stereo panner.